**CASE 1 – MINIMIZING SURFACE AREA: FIXED VOLUME, LOWEST SURFACE AREA**

In the problem below, Guy is dealing with a situation where the **volume** is fixed and he needs to create a box with the **lowest surface area** so that he will spend **the least** amount of money in material.

**Problem:** Guy has 64 m3 of sand and wants to make a box to hold it, using as little material as possible. He sketches three boxes. Determine which box will have the **least surface area**?

|  |  |  |
| --- | --- | --- |
| **Box 1** | **Box 2** | **Box 3** |
| Volume = 64 m3h = \_\_\_\_w = 4ml = 1m | Volume = 64 m3h = \_\_\_\_w = 4ml = 2m | Volume = 64 m3h = \_\_\_\_w = 4ml = 4m |
| SA = 2 (lw + wh + lh) = = | SA = 2 (lw + wh + lh) = = | SA = 2 (lw + wh + lh) = = |

|  |
| --- |
| The closer the box gets to being a \_\_\_\_\_\_\_\_\_\_\_\_\_, the smaller the **surface area** is for a given volume. |

**How to solve the problem above algebraically**

*We know that* ***cube*** *will provide the lowest surface area for a fixed volume of 64 m3 of sand. You need a calculator that has cube root button.*

**Tech Tip for**

$$\sqrt[x]{}$$

1) Type 3 for the root

2) Press $\sqrt[x]{}$

3) Type 64

$$\sqrt[3]{x}$$

1) Type 64

2) Press $\sqrt[3]{x}$



**Example:** State the dimensions that will **minimize** (lowest) the surface area of a shadow box that has a volume of 35937 cm3.

**CASE 2 – MAXIMIZING VOLUME: FIXED SURFACE AREA, MAXIMUM VOLUME**

In the problem below, Dorsa has a fixed amount of material (surface area) and needs to create a box that will provide the largest volume to fit the most amount of toys.

Dorsa has 24 m2 of wood to make a toy box. Determine which box will have the maximum volume.

|  |  |  |
| --- | --- | --- |
| **Box 1** | **Box 2** | **Box 3** |
| Surface Area = 24 m2h = 1.6w = 4ml = 1m | Surface Area = 24 m2h = \_\_\_\_w = 3ml = 2m | Surface Area = 24 m2h = \_\_\_\_w = 2ml = 2m |
| **How to get h**SA = 2 (lw + wh + lh) 24 = 2 (1x4 + 4h + 1h) 24 = 2(4 + 5h) 24 = 8 + 10h 16 = 10h1.6 = h | SA = 2 (lw + wh + lh) = = | SA = 2 (lw + wh + lh) = = |
| **Volume Box 1:** **V = l x w x h** | **Volume Box 2:**  | **Volume Box 3:**  |

|  |
| --- |
| The closer the box gets to being a \_\_\_\_\_\_\_\_\_\_\_\_\_, the **larger** the volume is for a given surface area. |

**How to solve the problem above algebraically**

*We know that cube will provide the largest volume.*

Determine the dimensions of a box that maximizes the volume and has a surface area of 54 cm2.

**Questions**

1. A magician has ordered a covered water tank for his next new act. He has enough money to pay for 150 m2 of building material. What is the largest volume of water that can be held in his water tank?

2. Dunstin and Carmila’s kids need a place to put all of their toys. Dunstin decides to build them a toy box, but he only has 54 cm2 of wood to make the box. Will he be able to make a toy box and lid that will hold all the kids toys if they have a total volume of 32 cm3? (Do not worry about actual size of the toys, since smaller toys and fit amongst the larger ones).

3. State the dimensions that will minimize the surface area of a shadow box that has a volume of 19683 cm3.

4. You have been asked to make a single shelf cabinet, with a volume of 4.5 m. However it can only be 0.5 m deep.

1. Determine the dimensions that will minimize the surface area.

b) Assuming that the front face of the shelf is open, what total surface area of wood is needed?

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